UNIVERSITI PUTRA MALAYSIA

A SIMULATION STUDY ON COMPETING RISKS WITH CENSORED DATA USING COX MODEL

IING LUKMAN

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By

IING LUKMAN

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A SIMULATION STUDY ON COMPETING RISKS WITH CENSORED DATA USING COX MODEL

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December 1999

Chairman: **Noor Akma Ibrahim, Ph.D.**

Faculty: **Science and Environmental Studies**

A simulation study was performed to compare two regression methods for competing risks with censored data. The first method was the conventional Cox's proportional hazard regression model (Cox model). The second method was based on Cox model using a duplicated data technique of Lunn and McNeil (or the modified Lunn-McNeil). Samples with various sizes and censoring percentages were generated and fitted using both methods. This study was conducted by comparing the inference of both methods, using Root Mean Square Error (RMSE), the power tests, and the Schoenfeld residuals analysis. The power tests used in this study were likelihood ratio test, Rao-score test, and Wald statistics. The Schoenfeld residuals analysis was conducted to check the proportionality of the model through its covariates. The estimated parameters were computed for cause-specific hazards. Results showed the RMSE were

generally smaller for the model of the modified Lunn-McNeil method than that of the ordinary Cox method. The power tests of the likelihood ratio statistics and Rao-score test were only powerful for the unstratified Cox model, so that, it could be concluded that the model had more advantages than the modified Lunn-McNeil one. However, results from the analysis of Schoenfeld residuals indicated that the modified Lunn-McNeil was better than the ordinary Cox in complying with the proportional hazards model assumption with respect to certain covariates.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

KAJIAN SIMULASI TERHADAP RISIKO BERSAING DENGAN DATA TERTAPIS MENGGUNAKAN MODEL COX

Oleh

IING LUKMAN

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Pengerusi: **Noor Akma Ibrahim, Ph.D.**

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Kajian simulasi dijalankan untuk membandingkan dua kaedah regresi bagi risiko bersaing dengan data tertapis. Kaedah pertama ialah model regresi kadaran bahaya Cox biasa (model Cox). Kaedah kedua ialah model Cox yang berlandaskan pada penggunaan teknik data yang sama dari Lunn dan McNeil (atau kaedah Lunn-McNeil terubahsuai). Beberapa sampel dengan saiz berbeza dan peratusan tapisan berbeza dijana dan dianalisis menggunakan kedua-dua kaedah tersebut. Kajian ini dijalankan dengan membandingkan inferens dari kedua-dua kaedah tersebut, menggunakan Punca Kuasadua Min Ralat (PKMR), ujian kuasa, dan analisis reja Schoenfeld. Ujian kuasa yang digunakan ialah ujian nisbah kebolehjadian, ujian skor-Rao, dan statistik Wald. Analisis reja Schoenfeld dijalankan untuk meneliti keseimbangan model menerusi kovariatnya. Anggaran parameter dihitung bagi punca bahaya tertentu.

Keputusan menunjukkan PKMR secara amnya lebih kecil bagi model Lunn-McNeil terubahsuai berbanding dengan kaedah Cox biasa. Ujian kuasa dari statistik nisbah kebolehjadian dan ujian skor-Rao adalah hanya berkuasa bagi model Cox takberstrata, jadi dapat disimpulkan bahawa model ini memiliki kelebihan ke atas kaedah Lunn-McNeil terubahsuai. Bagaimanapun, keputusan daripada analisis reja Schoenfeld menunjukkan bahawa Lunn-McNeil terubahsuai adalah lebih baik berbanding Cox biasa kerana ia mematuhi andaian model kadaran bahaya meskipun untuk beberapa kovariat tertentu sahaja.

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I certify that an Examination Committee met on 30 December, 1999 to conduct the final examination of Iing Lukman on his Master of Science thesis entitled "A Simulation Study on Competing Risks with Censored Data Using Cox Model" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and was accepted as fulfilment of the requirements for the degree of Master of Science.

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions

(IING LUKMAN)

Date: 01/3/2000

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